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A FORECAST OF TECHNOLOGICAL EDUCATION

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As a form of intellectual effort, forecasting is more notable for its ability to survive failures than for its successes. It flourished with the soothsayers of Egypt and the oracles of Greece; it lost none of its vogue in the hands of the astrologers of the Middle Ages; it is practised to-day by tipsters, weather prophets, investment counselors and a host of similar services.

Wishful thinking and the fact that "hope springs eternal in the human breast" account in part for the hold that forecasters have on us, as does also the human frailty of trying to shift responsibility by making decisions. More fundamental, however, is the fact that almost every rational action has to be based upon some sort of forecast of its future results. Rational human beings, therefore, must of necessity be forecasters.

The progress of civilization may be measured by the trend from superstition to science in forecasting, but this trend has been immensely more rapid in some fields than others. Astronomers can predict an eclipse with stop-watch accuracy a century in advance; psychologists have made at least some progress in ability to forecast probable success in different occupations by measuring students' aptitudes; medical men are as yet powerless to foretell when or where the next epidemic of infantile paralysis will break out. All grades of forecasting, from hocus-pocus and racket to art and science, coexist as part of man's struggle for a more satisfying life.

Having thus defined the field and exposed the uncertainties of forecasting, I immediately confess that my present ex-

cursion into this realm lies somewhere in the scale between racket and science, at about the point usually described as "hunch." My logic may be faulty or unforeseen conditions may arise to change the picture, but, as I see it, technological education in the future will show the following characteristics:

(1) The importance of technological education will continually increase. This appears to be the sure result of three factors: first, the increasing competition which is forced upon individuals and organizations as the opportunity for free expansion into the unoccupied frontiers of the West disappears; second, the necessity of using and husbanding our natural resources more wisely as these become less and less available for easy and wasteful exploitation; third, the increasing applications of science to minister to human needs and desires, which are so important a feature of our so-called rising standard of living.

(2) There will be increasing differentiation between technological and technical training, *i.e.*, between the engineering school and the trade school. The field is rapidly becoming too complex to be included in one and the same curriculum, and the school which attempts to straddle both will succeed in neither.

(3) Large industrial units or associations will increasingly establish their own trade schools to train expert technicians for their own special purposes. Private or public technical schools will similarly supply the general needs of the surrounding industrial communities for skilled mechanics, lithographers, textile workers, electricians, draughtsmen, and the like.

This system will practically replace the older apprentice system which, for better or worse, is rapidly disappearing.

(4) Undergraduate curriculums in technological schools will increasingly avoid specialization except in rather general fields, and will devote increasing attention to physics, chemistry, and the general principles and methods of engineering, with supplementary education in social science and training in the art of exposition. Such broad and basic training is needed to give the vision and adaptability required for positions of responsibility in a world of activities which are increasingly dependent on applications of science in new and varied ways.

(5) As a corollary, the increasing need for many technological specialists will be met by the graduate curriculums, and we may expect a continuation of the recently growing emphasis on graduate study.

(6) We will see increasing differentiation in scope and more logical adaption to environment in our colleges and universities. This will be forced upon them by competition or achieved voluntarily after wise appraisal of opportunities. Most of our present colleges were founded in the era of horse and buggy or limited rail transportation. Most of them were intended to minister to local educational needs. As transportation becomes faster and easier, and the people become more travel minded, why should an ambitious young man try to secure a specialized training for a profession at Podunk College, when a few hours of travel will give him the superior education of a great institution?

Obviously this tendency is more pronounced in the higher grades of the educational system, such as the professional and graduate schools. We will, therefore, see many a smaller or less favorably situated institution drop its ambitious attempts to encompass the whole field of education and concentrate its resources to do the best possible job as an under-

graduate or a junior college, perhaps retaining some special field of local significance. At the same time, the higher ranges of education will be concentrated in the most favorably situated institutions. Even among these, the selective process will operate, and we will see a few of them emerge as superprofessional schools, with the graduate aspect strongly emphasized.

(7) Research will become a continually more important activity in the leading technological schools. Two important factors conspire to bring this about, one pedagogical and the other social.

As to the first of these, it will suffice to remark that research, *viz.*, investigation and report of some problem conducted intensively and relatively independently by a student, aided by all the resources of library, laboratory and consultation which he can marshal, supplies a test and training for an important element of his future career, which are not afforded by ordinary classroom or laboratory methods of instruction. Research, as for graduation theses, is a more expensive type of training than lecture, quiz and laboratory exercise; it is far more difficult to handle properly by the faculty, but if so handled it is likely to be fascinating to the student. I believe research to be capable of great development as a feature of education, both graduate and undergraduate, and those schools which are able to handle it adequately will take a predominating place in the educational world.

The social basis for research in educational institutions lies in the combination of urgent public need for research and unique opportunities for performing some kinds of research in educational institutions. Such institutions have extensive and varied laboratory equipment, large staffs in many related fields of science and art, and a great supply of young men available as students or apprentices to work under expert guidance. There

is thus a dovetailing of interests and facilities between education and research, which is mutually most favorable.

Public welfare calls for research from a multitude of angles; new developments in industry, public health, agriculture and all technical fields depend on progress in pure science and development of new materials, processes and methods. While industrial organizations can profitably conduct research on problems related to their specific interests, and governmental agencies can properly undertake research in specific fields of wide public interest, none of these is justified or equipped, as are the educational institutions, to engage in the general advancement of knowledge on which all depend in the last analysis.

For such reasons I look for an increased activity in research in the technological schools and for their support by the public in this activity. Such support will come in a variety of ways: by gifts from public-spirited benefactors; by contracts from industrial associations for investigation and report on fundamental or obscure problems of general interest to the associations; by grants directly by the government in support of important scientific programs. The first of these is one of the finest outgrowths of the American capitalistic system; the last two are logical ways in which the benefits of research, specifically rather unpredictable but of unquestioned value in the aggregate, may be supported by the group for the general good. Recent practices of certain governmental bureaus and provisions in Congressional bills indicate a strong trend toward recognition of research in educational institutions—even outside the land-grant group—as a proper and desirable expenditure of public money.

(8) Finally comes the question: “Will increasing taxation and other methods of forcibly distributing wealth so cripple private philanthropy in this country as

to sound the death knell of the privately supported educational institutions, leaving all education in the hands of the state?” Inflation and taxation in an essentially socialistic state could accomplish this. If it should happen, education would be a major loser in the general catastrophe. Fully admitting the splendid work of many state-supported universities and their essential contribution to our national life, it is, nevertheless, the independent institutions which have set the pace and maintained the intellectual integrity and freedom of our entire educational system. Lose them, and the whole structure is freely exposed to the danger of political manipulation and domination.

Private institutions can pay their key men salaries larger than those of the average voter or political office holder, can undertake intellectual projects of no obvious practical value, can report facts or announce theories without thought of the political strife of the moment. Such things are not so easy in a state-controlled school, and would be vastly less easy if the bulwark of tradition and example of the private institutions were destroyed. State institutions suffer under still other handicaps: It is easier to get appropriations for buildings, which show, than for the staff, which really makes the institution; the institutions tend to become pawns in the game of taxation and budgets, with the staffs playing the rôle of very nervous onlookers and the presidents forced to mingle lobbying with educational administration; the pressure to expand activities and serve all groups works against concentration on essentials and maintenance of high standards. Elimination of independent educational institutions would, therefore, not only sacrifice educational leadership, but would enormously increase the difficulties in spite of which the state institutions are now performing their functions so splendidly.

I do not believe that the basic good sense of the American people will permit these things to happen. I believe that our tradition of freedom, initiative and individual rights will continue to develop men and women who will acquire wealth and who will wish to use it for outstanding benefits to the general social group, in which education is an important element. I do believe that the economic trends are making the path of the private institutions more difficult and that some of them will succumb. The trend, I believe, will be for state institutions to assume more of the burden of ordinary education, expanding from the public-school field into the junior-college field, thus substituting education in place of unemployment.

CONCLUSION

If these forecasts do not entirely miss the mark, they offer both encouragement and guidance in our efforts to make the privately controlled institutions of technology of the future preëminently strong and serviceable institutions. Above all, they indicate that the *criterion for survival of a private institution will be that it offers a quality of education and public service, definitely superior to that obtainable in government-operated institutions.* This is the challenge of the future to those who administer the affairs of private institutions and to those who wish such institutions to endure as vanguard and bulwarks of a free and progressive social order.

PIANO TOUCH

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ONE is tempted to say that touch is the touchiest subject in musical circles, because we are deeply impressed with the enormous possibilities for characterizing musical artistry and expression of musical feeling in terms of this art. The vocabulary descriptive of touch now current is extensive, loose and baffling. Historically, but little effort has been made to aid the student in music by bringing order out of this chaos from a scientific point of view. However, recent scientific approaches to this subject have made progress and give assurance of the possibility of an adequate analysis, description and terminology for many of these phenomena. The best available book on the subject for musicians is the volume by Professor Ortmann, director of the Peabody Conservatory of Music. It is based upon a searching analysis of historical, theoretical and experimental evidences. His principal findings may be summarized as follows:

The pianist has at his direct control

only two of the four factors in music; namely, intensity and time. Pitch and timbre are determined primarily by the composer and the instrument.

The pianist can control the intensity only in terms of the velocity of the hammer at the moment at which it leaves the escapement mechanism, and by the action of the pedals.

There are only two significant strokes on the key: the percussion and the non-percussion. The difference between these is that the former contributes more noise to the piano tone and the latter gives the player better control of the desired intensity.

Aside from the addition of the noise, the player can not modify the quality of the tone by the manner of depressing the key or by manipulations after the key has struck its bed except, perhaps, by a momentary partial key release and immediate key depression, damping the tone somewhat but not entirely.

He can control the time factors which